

B-F effect in astronomical and fringe data

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Data taken in 2009 by
O'Connor, Kotov, Haupt,
Crofts et al at MDM
Observatory (Kitt Peak) 2.4m
Hiltner Telescope

Early LSST prototypes:

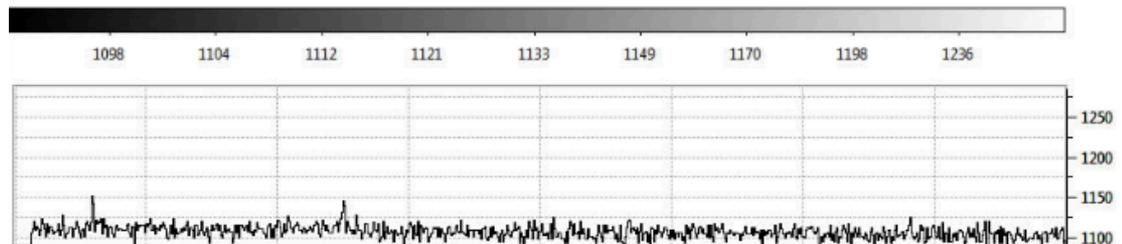
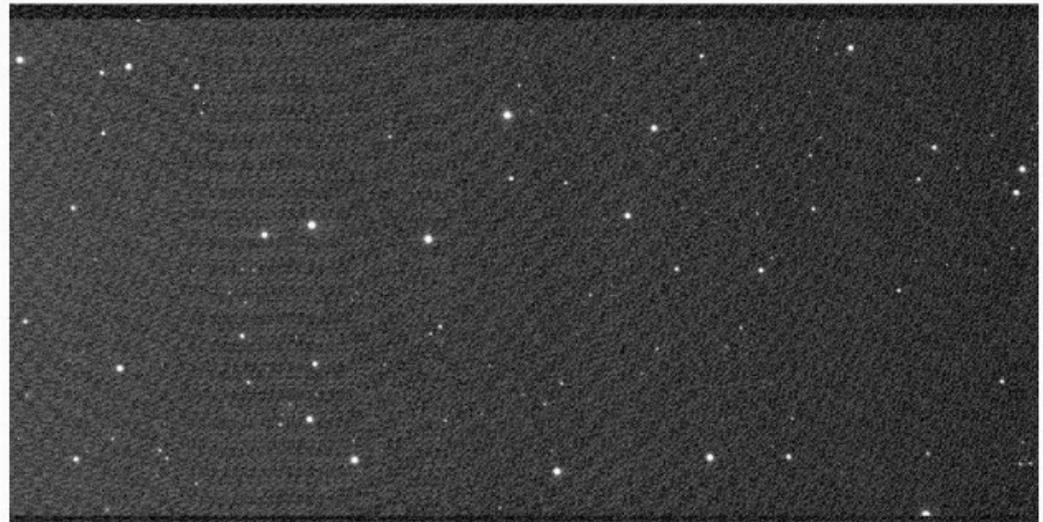
13.5 μm pixels

Plate scale 0.15"/pixel

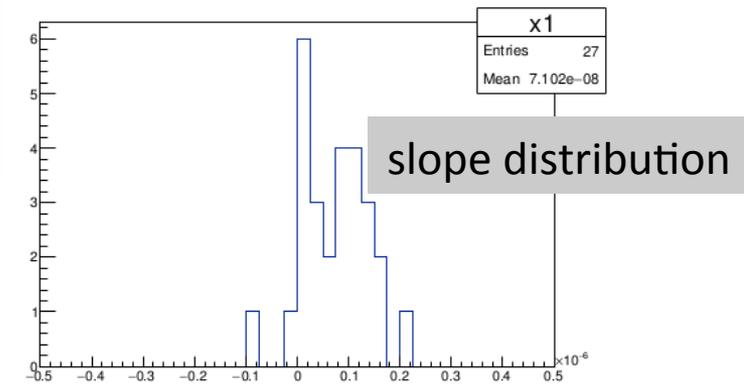
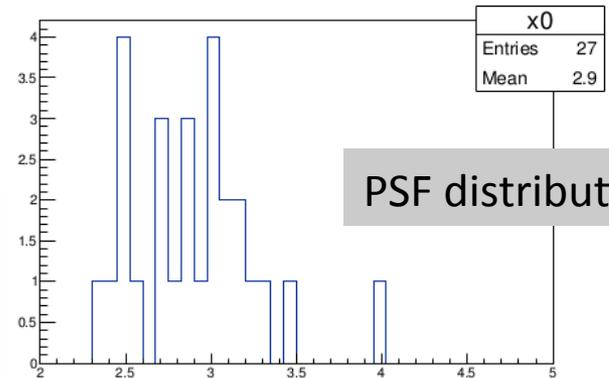
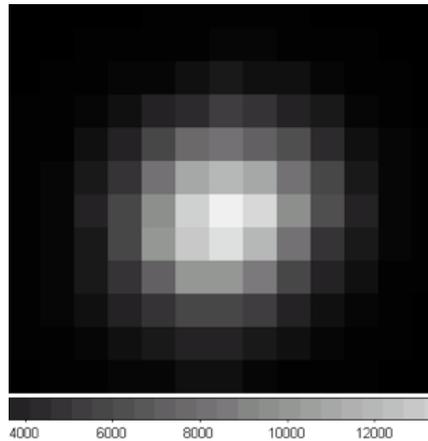
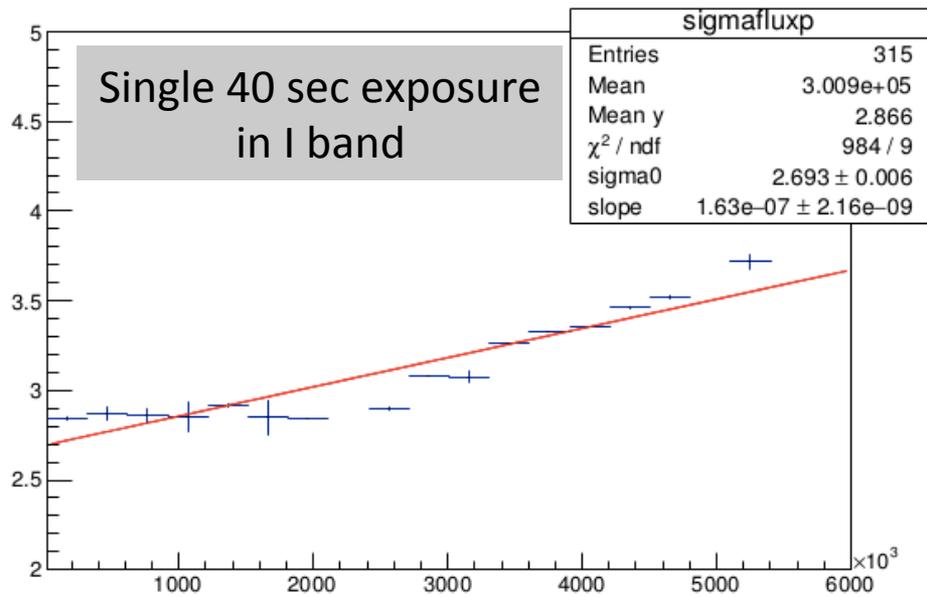
(LSST 0.2"/pixel)

Looked at NGC7209 field

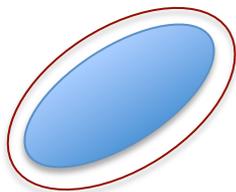
~ 250 stars/ 40 sec exposure



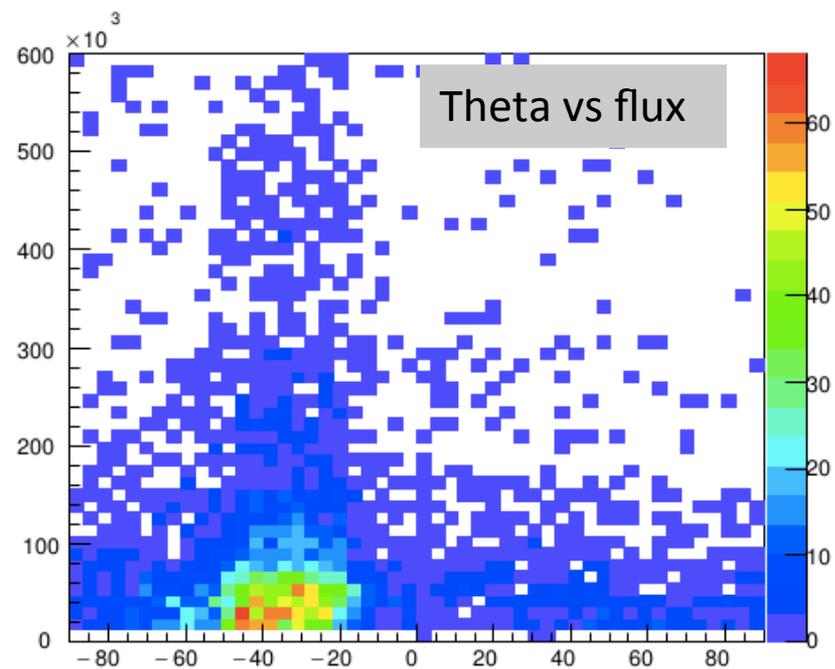
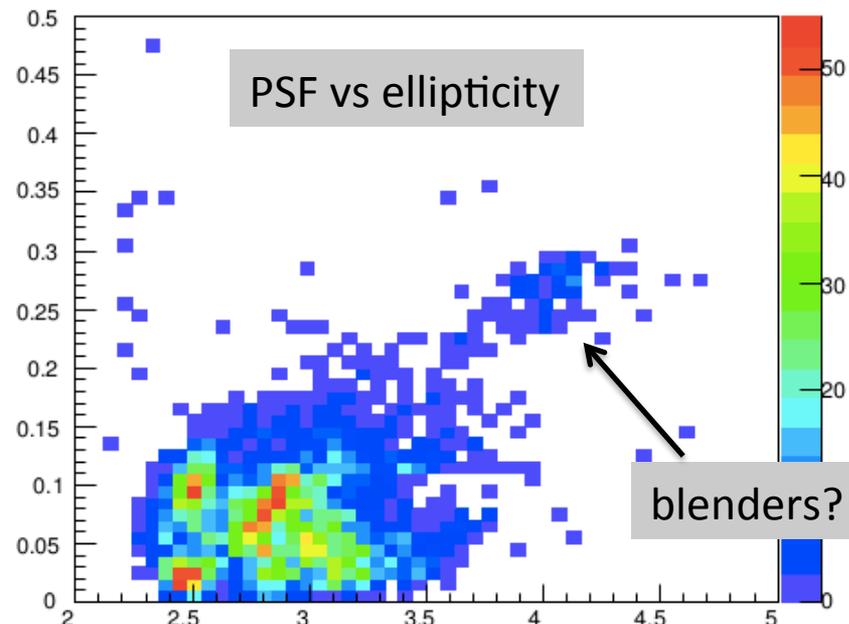
- Used long exposures (40 and 20 sec)
- Find stars using ngmix and fit with 2D Gauss
- For each exposure: plot PSF of all objects in flux bins
- See B-F at a few % level over the whole dynamic range



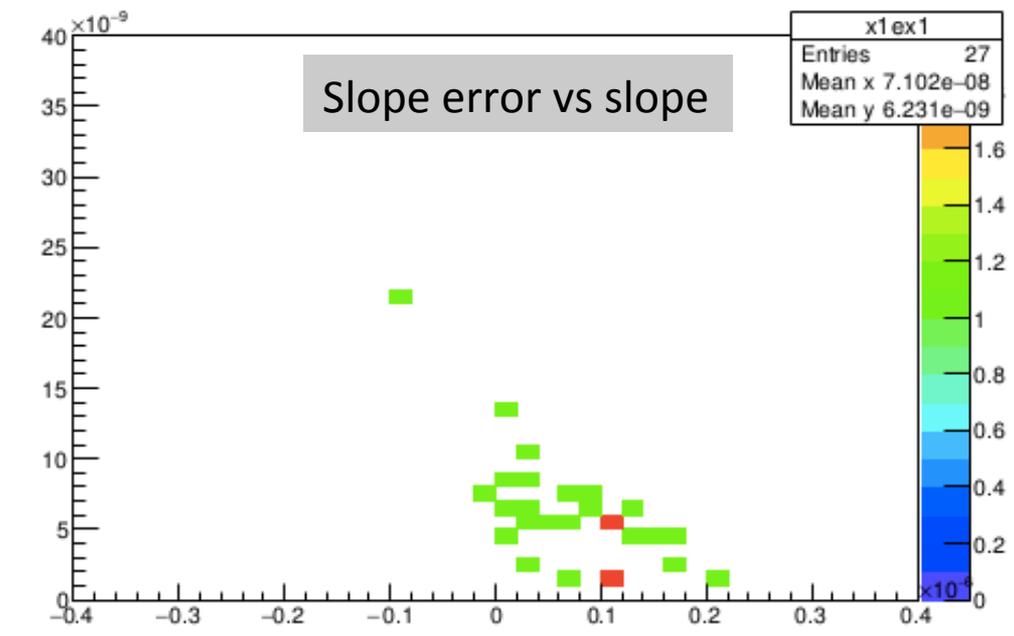
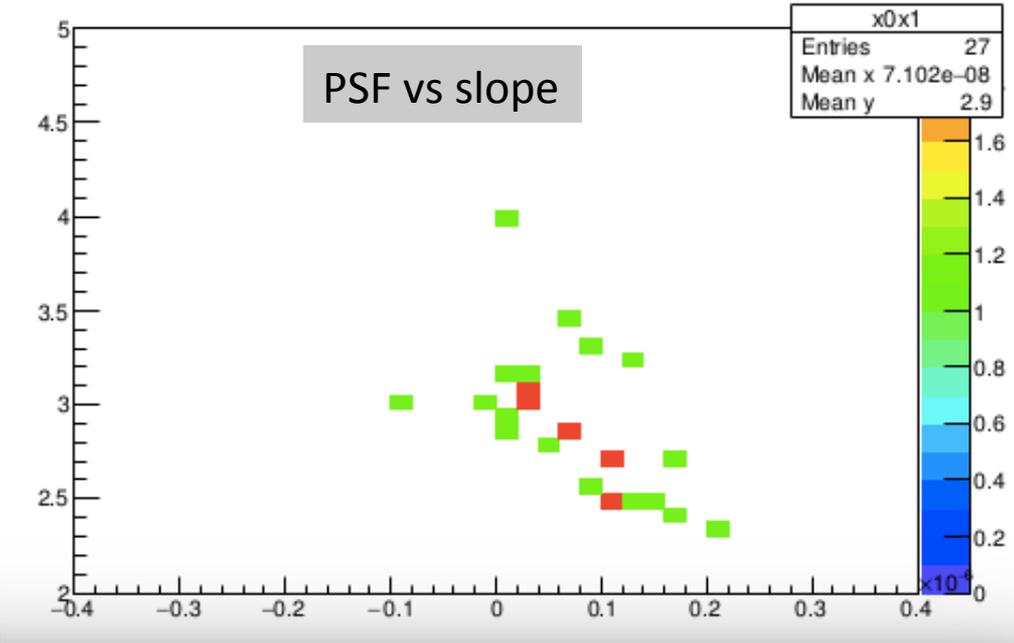
- PSF is large due to atmosphere. Why we see B-F at all?
 - Clearly the resulting B-F effect is not a convolution of sensor PSF with atmosphere and optics PSF



- Correlation plots: include all stars for exposures with >150 stars
 - Strong correlation in ellipticity direction

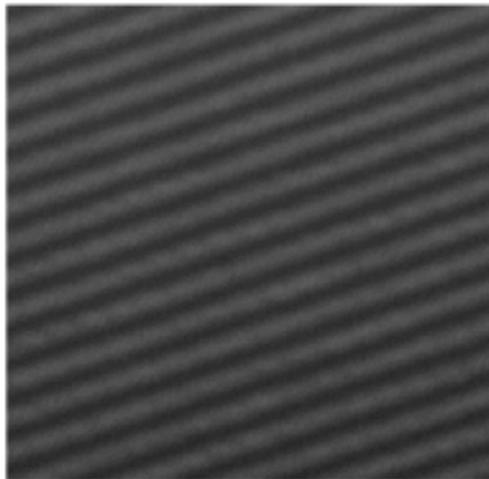


- Observe correlations, ex PSF vs slope, for different exposures
- Can it be described by *Astier et al 2014* and corrected as in *Gruen et al 2015*?
- Can it be simulated using physical model?
- Work in progress

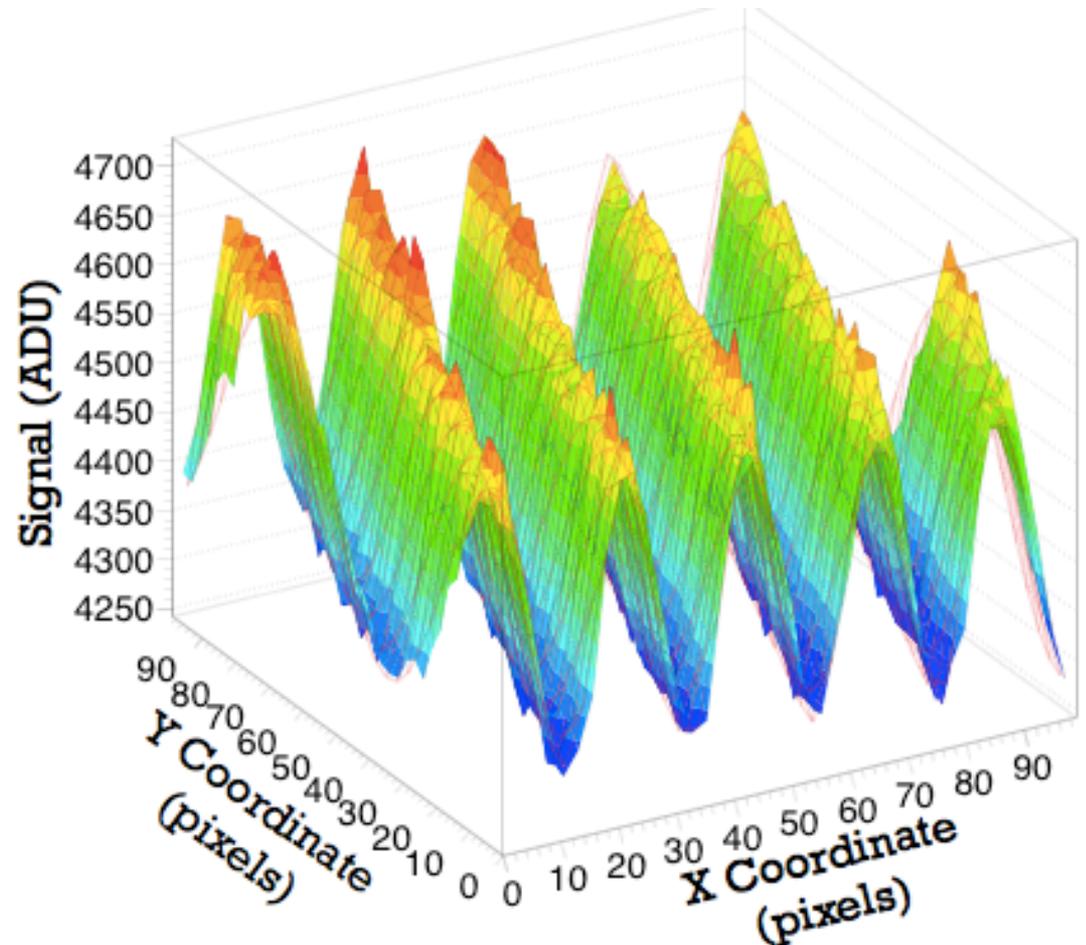


B-F with fringe projector

with Woody Gilbertson & Peter Takacs

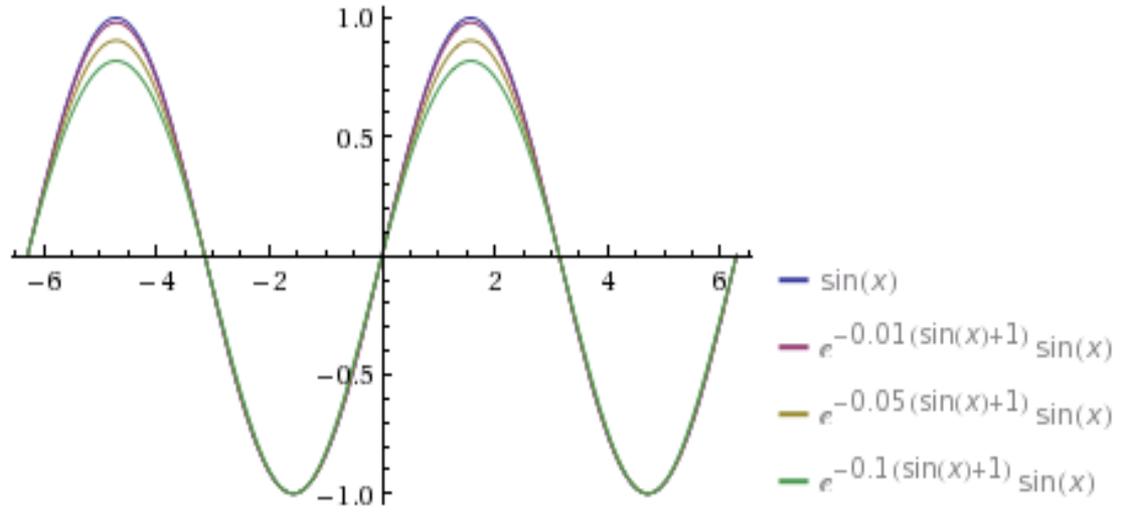


Assembled CCD Image



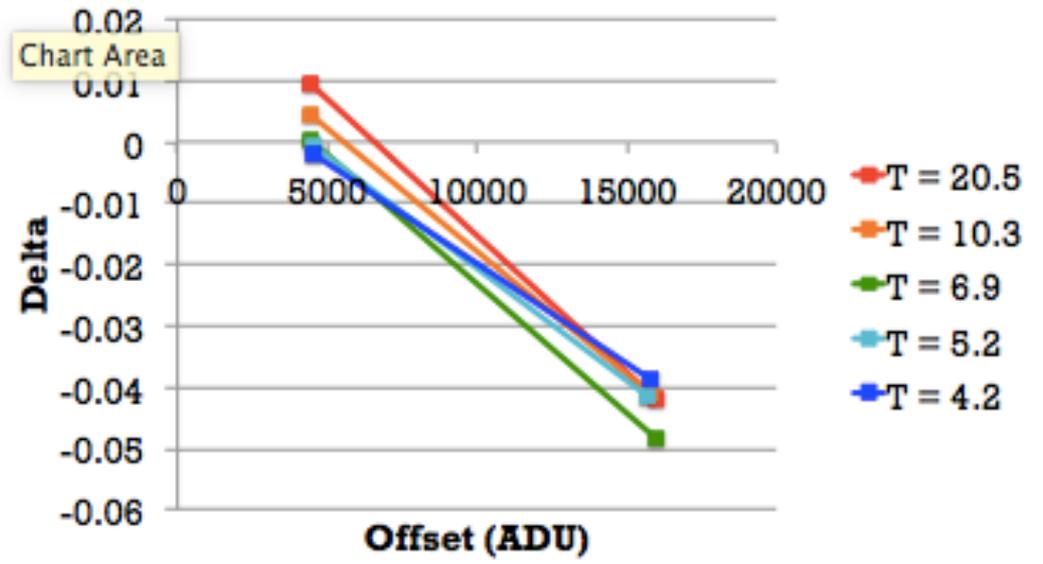
Resulting Data with fit

- Contrast 20-25 %
- Fit with asymmetric (in y) sine wave
- See dependence on intensity



$$e^{\delta(1+\sin x)} \sin x$$

Delta Changes with Intensity



$$\rho(x') = \int_{-\infty}^{\infty} A \sin(kx) \frac{\sigma}{\sqrt{2\pi}} e^{-\frac{(x-x')^2}{2\sigma^2}} dx$$

$$\sigma = \sigma_0(1 + \delta \sin(kx))$$

$$\rho(x') = \int_{-\infty}^{\infty} A \sin(kx) \frac{\sigma_0(1 + \delta \sin(kx))}{\sqrt{2\pi}} e^{-\frac{(x-x')^2}{2\sigma_0^2}(1-2\delta \sin(kx))} dx$$

- Work in progress to find a good empirical model
- Need to deal with above integral – use that δ is small, then use as fit function \rightarrow find δ
- Work in progress to improve the setup contrast
- Simulate using Poisson solver?